

# Liquid Argon R&D Facilities at FNAL & CERN

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*with much thanks to **Sebastien Murphy** and **André Rubbia** for help  
with CERN facilities*

CPAD Instrumentation Frontier Workshop

Arlington, TX

October 6, 2015

# Overview

- Many useful facilities exist at CERN and FNAL, which are available for use by university and lab colleagues to advance LAr R&D
  - Great resource for training students and postdocs
  - Shrinking resources in DOE: try to do more with less
- Disclaimer: of course there are non-LAr-specific facilities that exist as well, but not covered in this talk

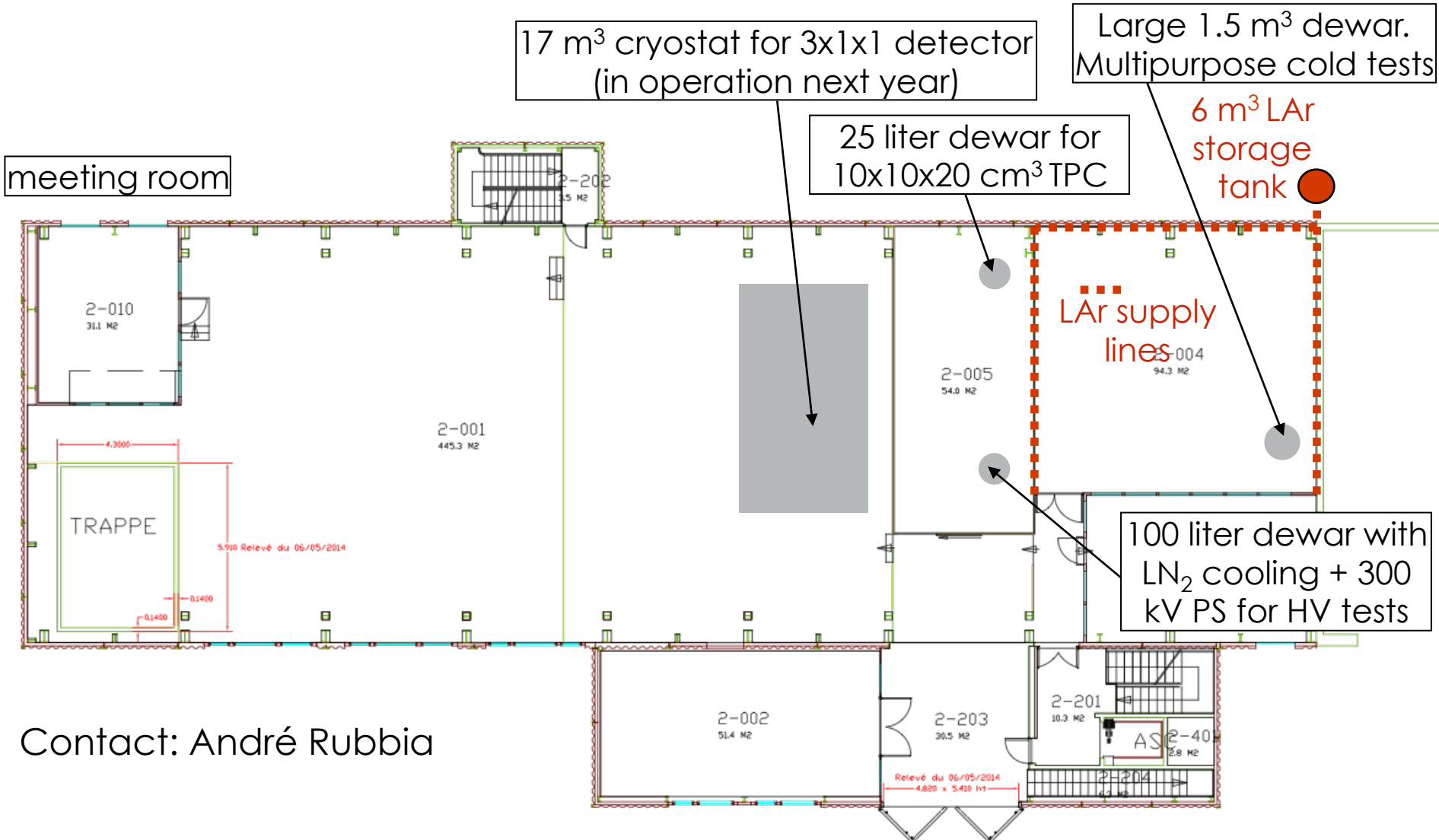


# CERN

- **Building 182:** Facilities overseen by WA-105 experiment
  - Has dedicated cryogenic infrastructure and several dewars, available to users by coordination with experiment
  - Short tests (~few weeks) can be agreed informally, longer tests (~few months) need approval through SPS committee
- **EHN1 area:** part of CERN neutrino platform
  - Two dedicated cryostats in test beam, can be used after protoDUNE and WA-105 complete tests
  - Approval through SPS committee

# CERN Building 182

WA105



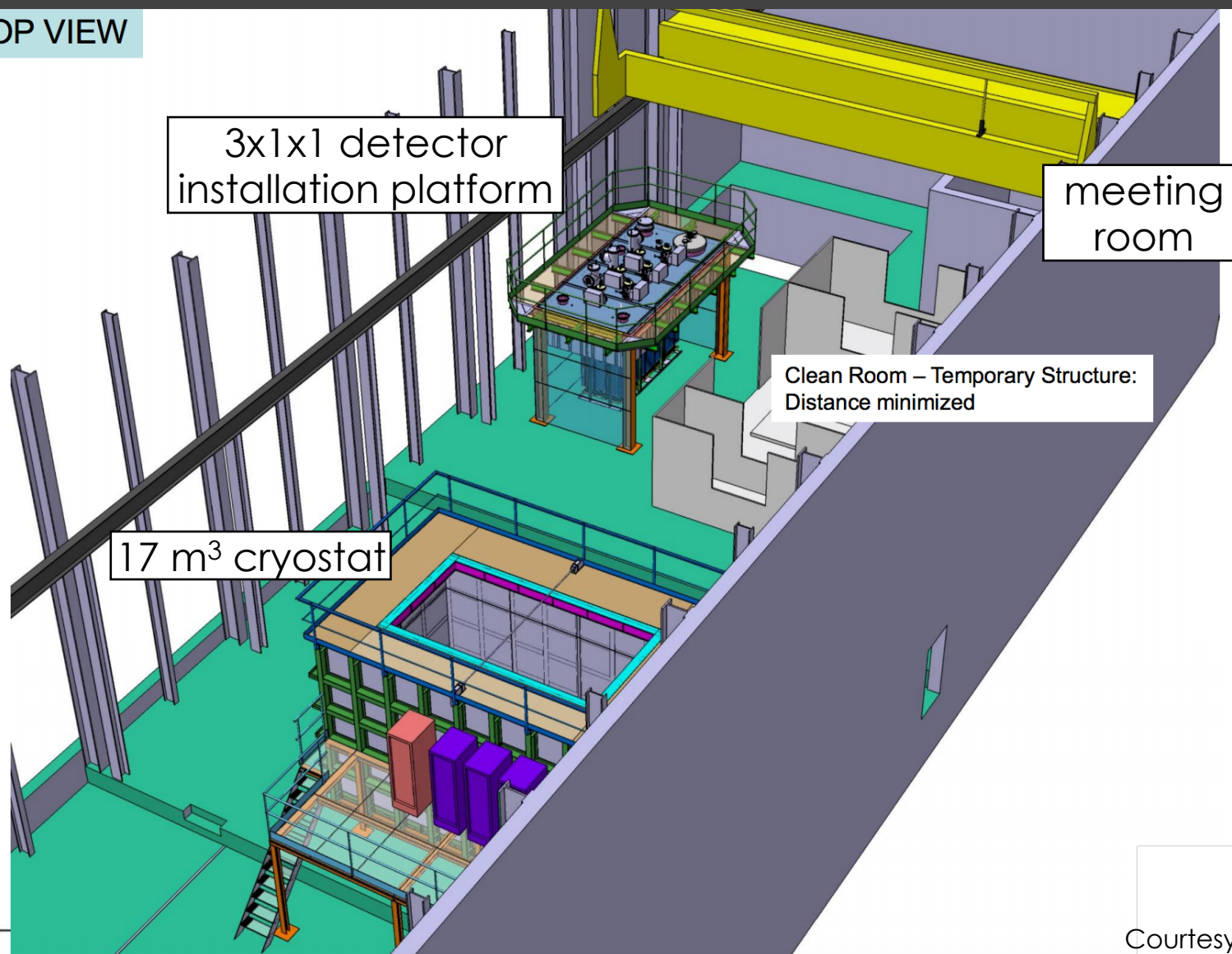
Contact: André Rubbia

Courtesy S. Murphy

# Building 182

WA105

TOP VIEW



Courtesy S. Murphy



# 17 m<sup>3</sup> membrane cryostat

WA105

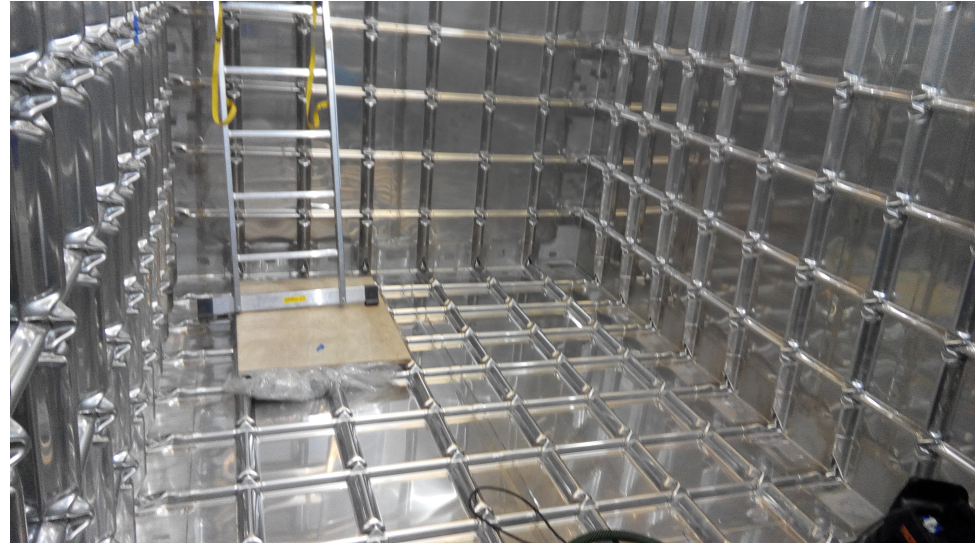


Courtesy S. Murphy



# 17 m<sup>3</sup> membrane cryostat

WA105



Courtesy S. Murphy

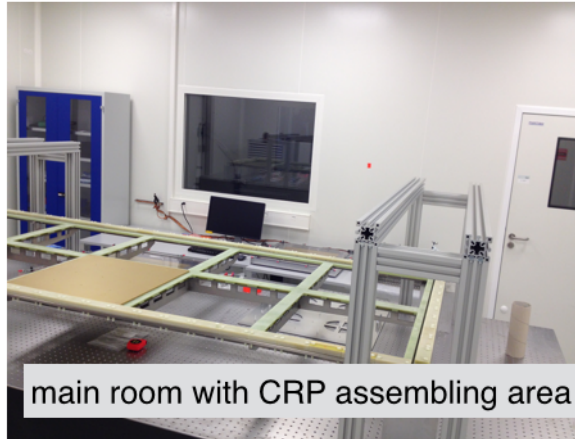


# WA-105 Clean Room

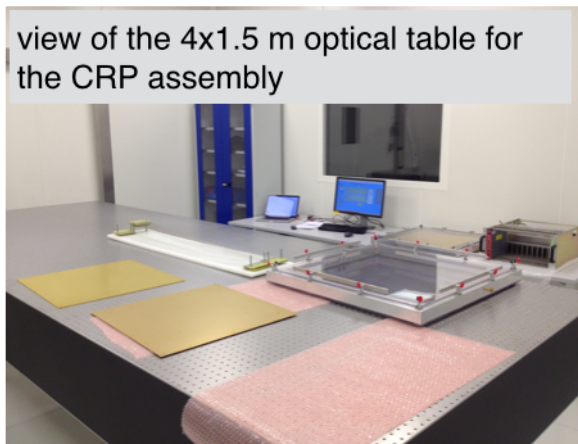
WA105



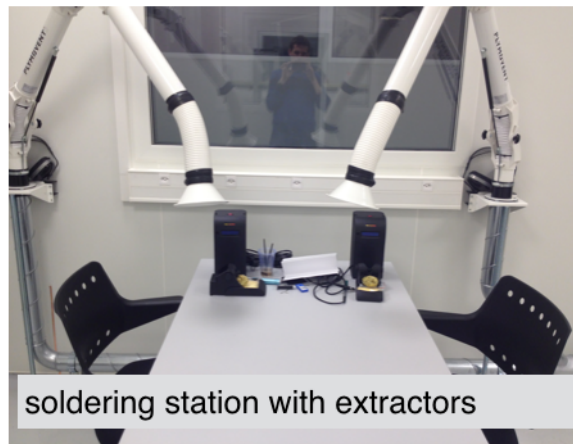
the clean room inside b. 182



main room with CRP assembling area



view of the 4x1.5 m optical table for the CRP assembly



soldering station with extractors



view of the soldering room

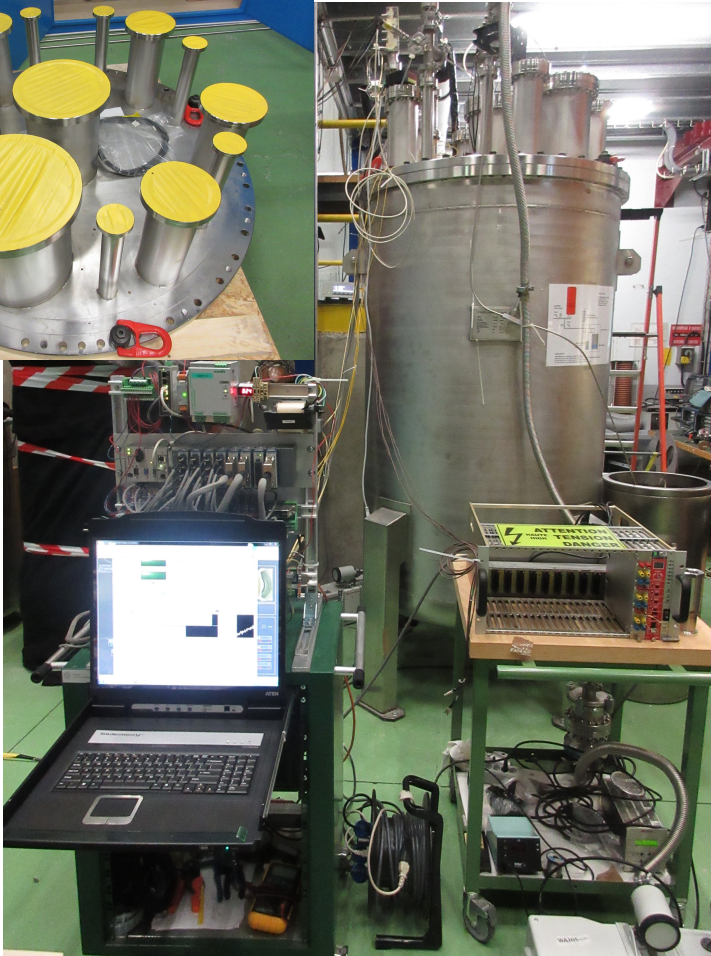
Courtesy S. Murphy



# 1.5 m<sup>3</sup> dewar

WA105

top cover with numerous flanges

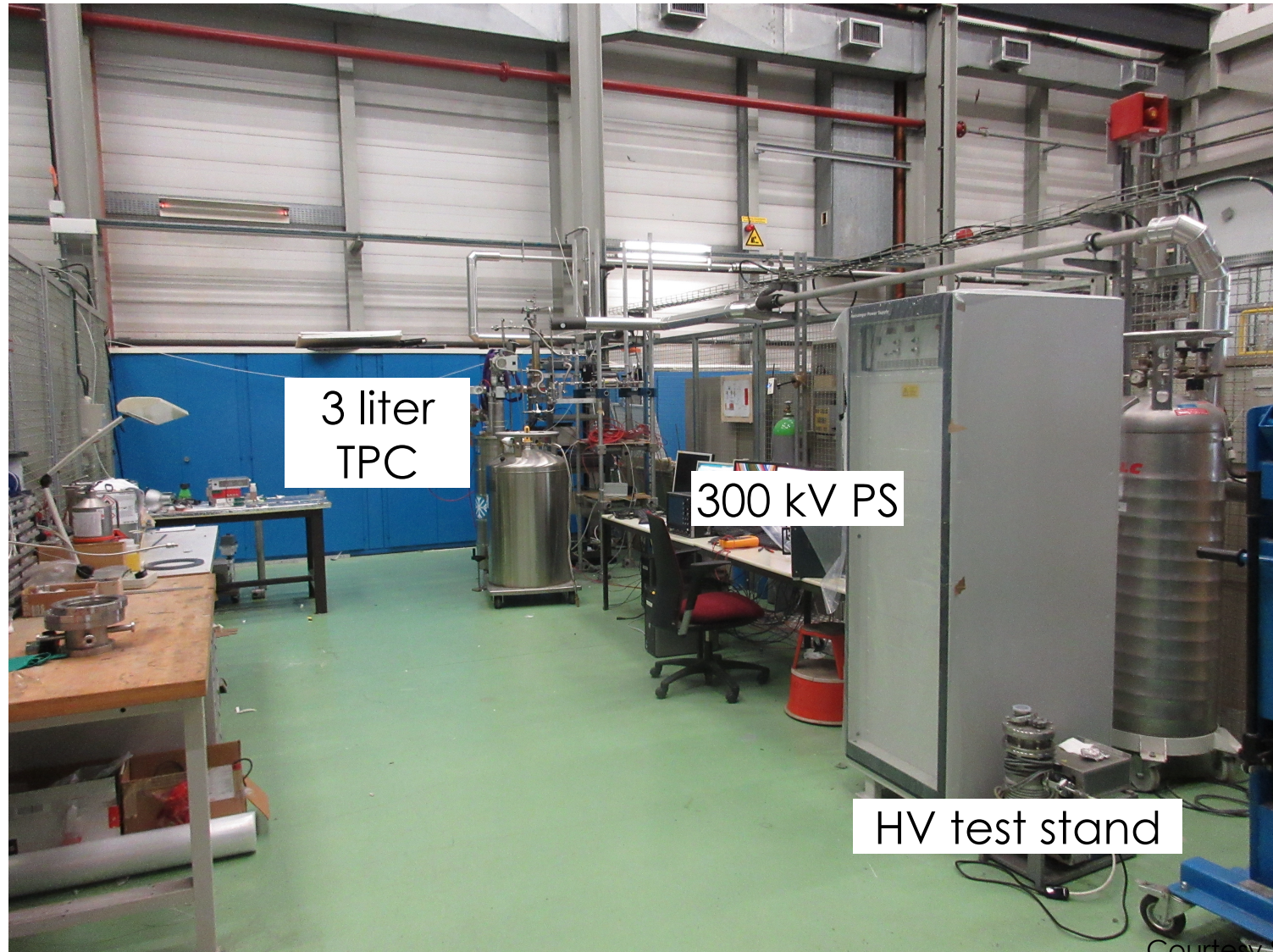


Courtesy S. Murphy



# Bldg 182 "Testing Zone 1"

WA105

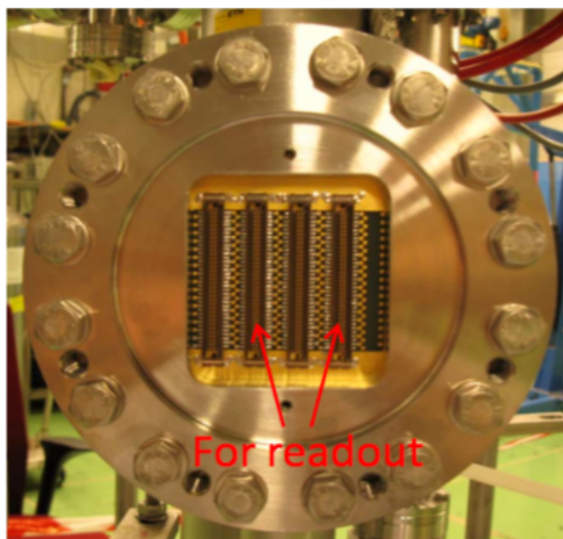
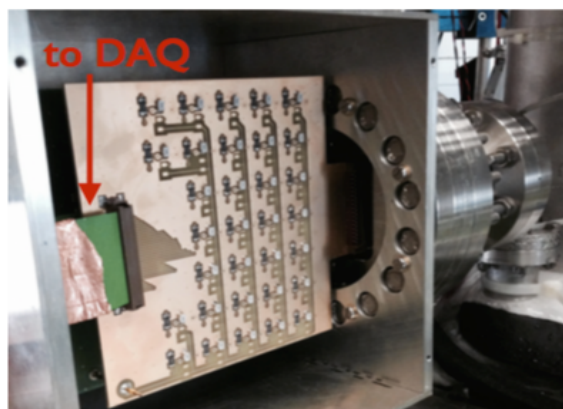
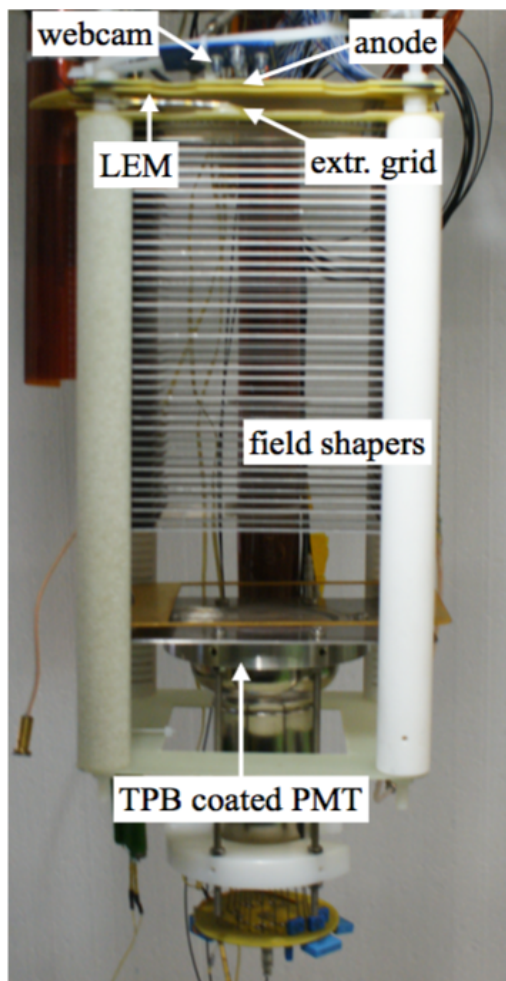


Courtesy S. Murphy



# 3-liter TPC

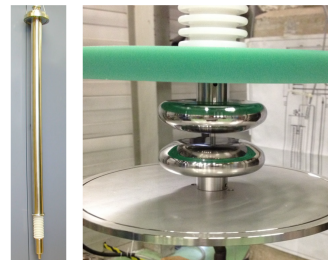
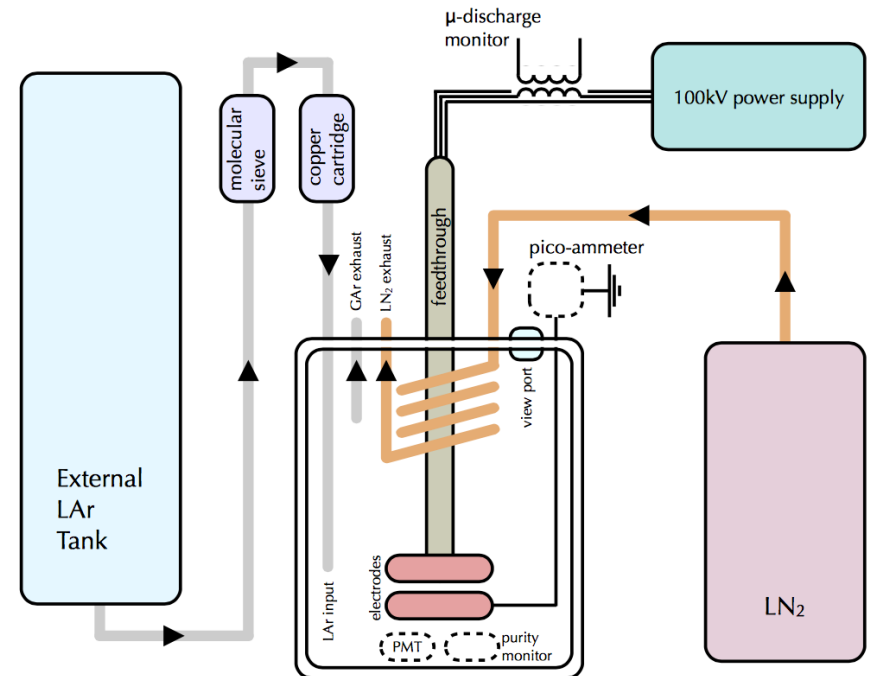
WA105



Courtesy S. Murphy

# HV Test Stand

WA105

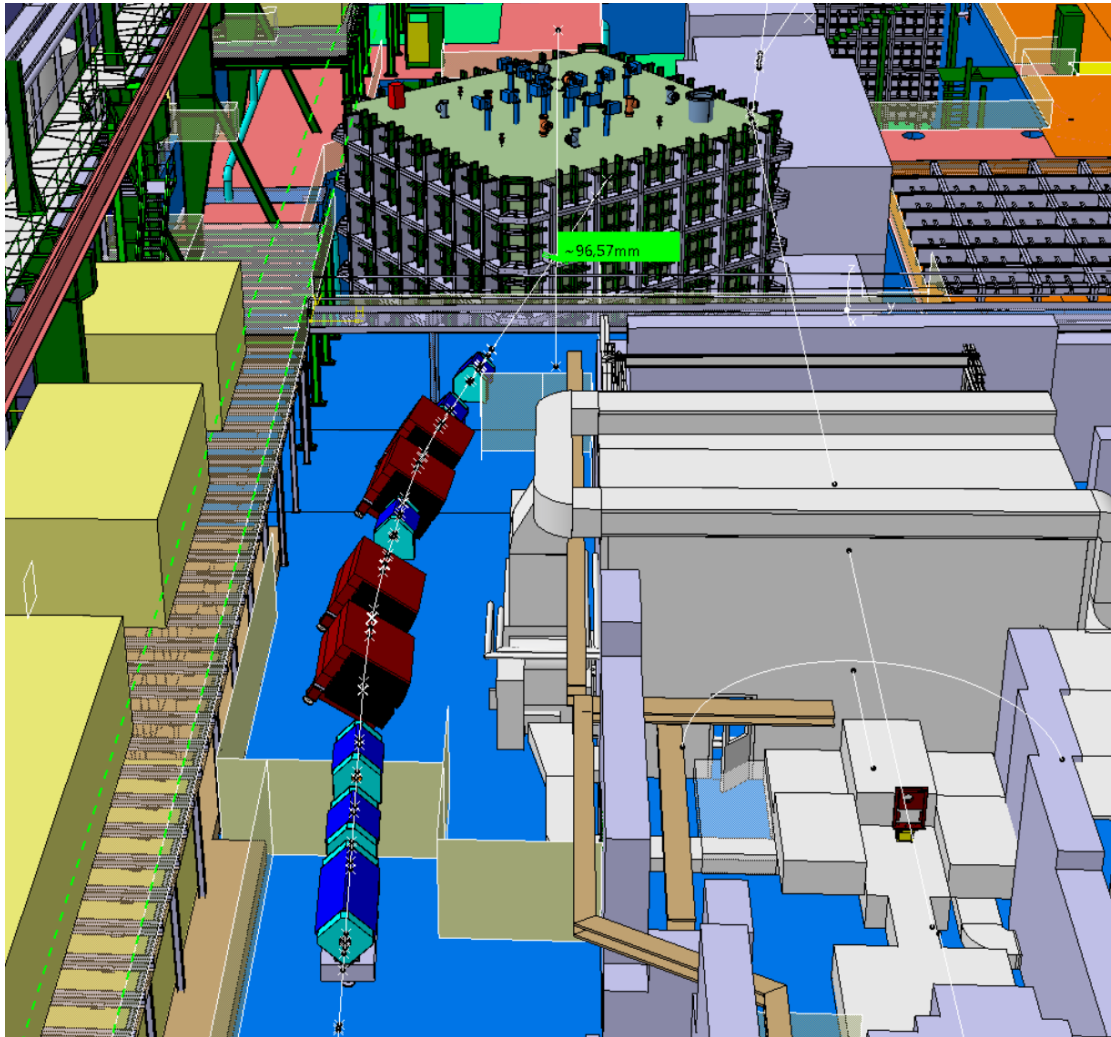


Rogowski shaped electrodes  
Currently measuring LAr rigidity

Courtesy S. Murphy



# CERN Neutrino Platform: EHN1

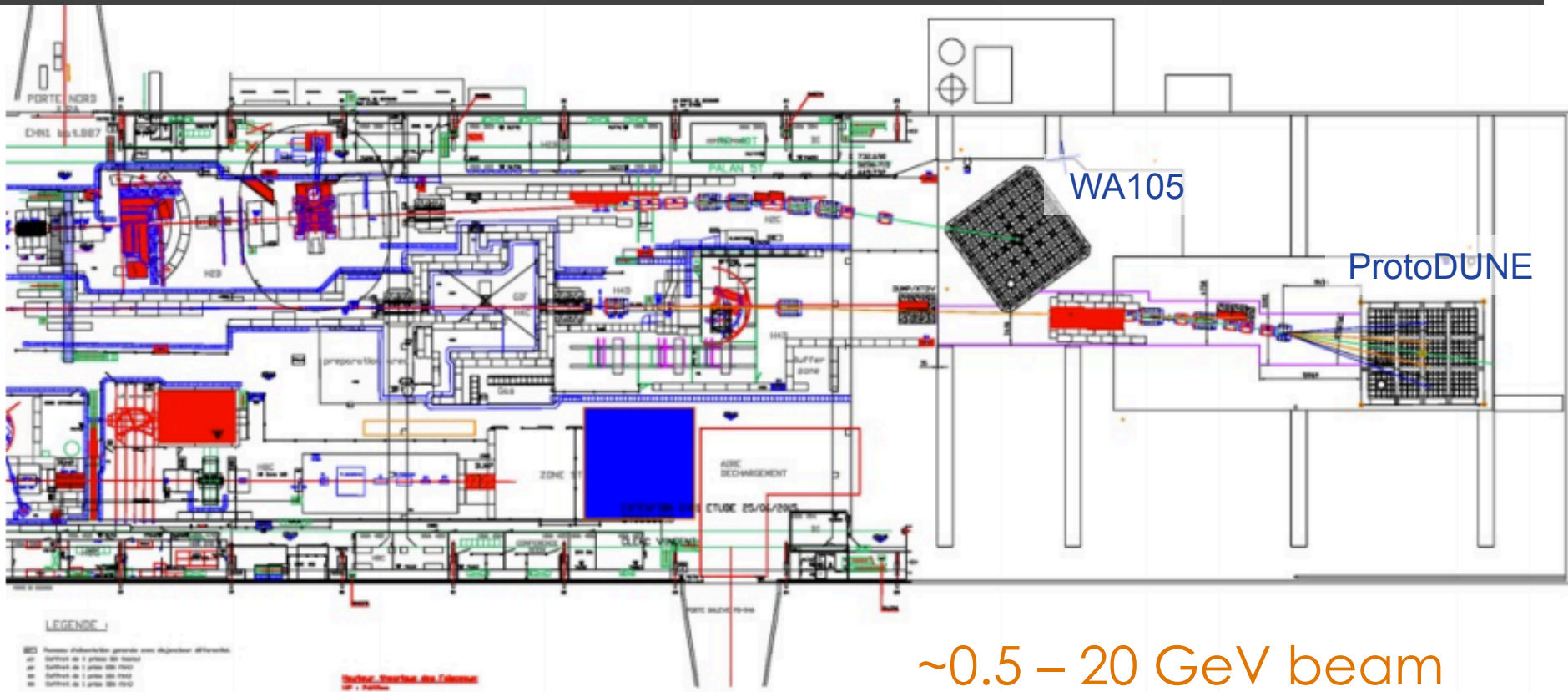


- Experimental Hall North 1
- Two  $8 \times 8 \times 8 \text{ m}^3$  cryostats in test beam
  - Testing single- and dual-phase detectors in parallel
  - Operational 2018-19, could be used for other R&D and testing when program is complete

Contact: Marzio Nessi

Courtesy S. Murphy

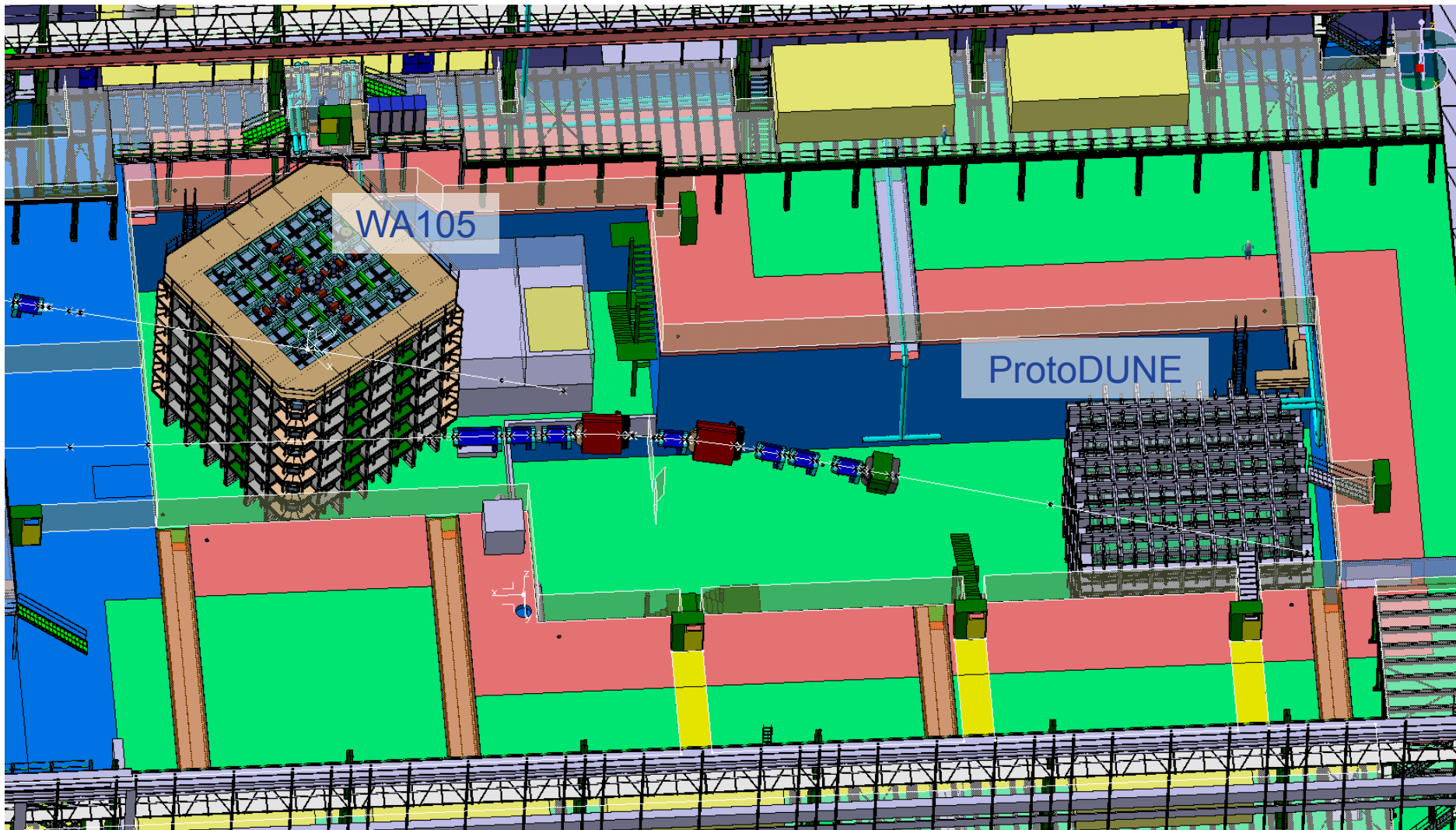
# EHN1 General Beam Layout



- How to request space and beam time:
  - Present LOI or EOI to CERN SPS committee
  - When approved, prepare (with help) an MOU defining responsibilities & resources
  - Then CERN experiment is created (WA104, WA105...) with all privileges and requirements

Courtesy A. Rubbia

# EHN1



Courtesy A. Rubbia

# FNAL

- **Proton Assembly Building** facilities with cryogenic infrastructure and several dewars
  - Approval through FNAL TSW (formerly MOU), with liaison assigned to help guide through approval process
- **PC4 Building:** 35-ton membrane cryostat and 30-ton LAPD cryostat with shared LAr circulation/filtration system
  - Approval through FNAL TSW process
- **Test Beam Facility**, MCenter beamline with support for LAr experiments after LArIAT completes its experimental program
  - Approval through FNAL TSW, with programmatic oversight by Test Beam Committee



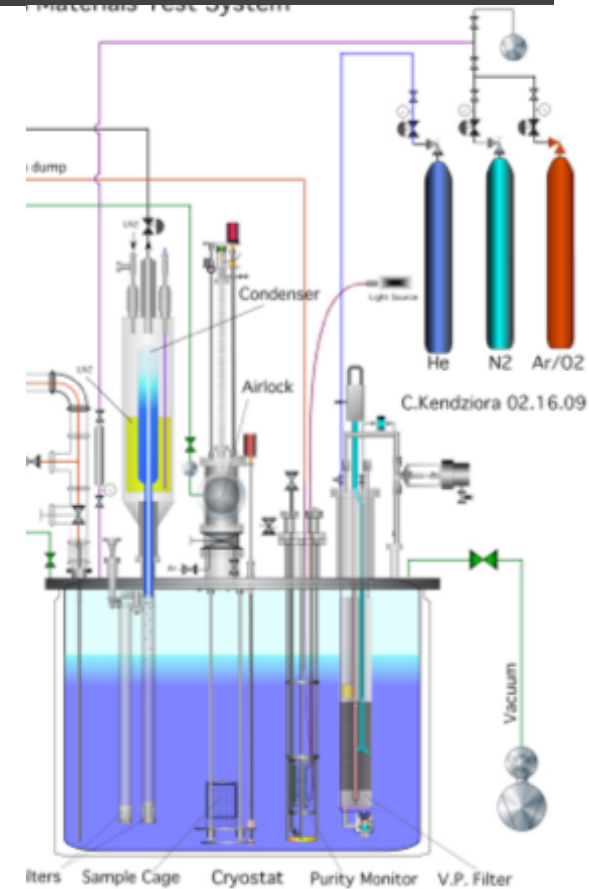
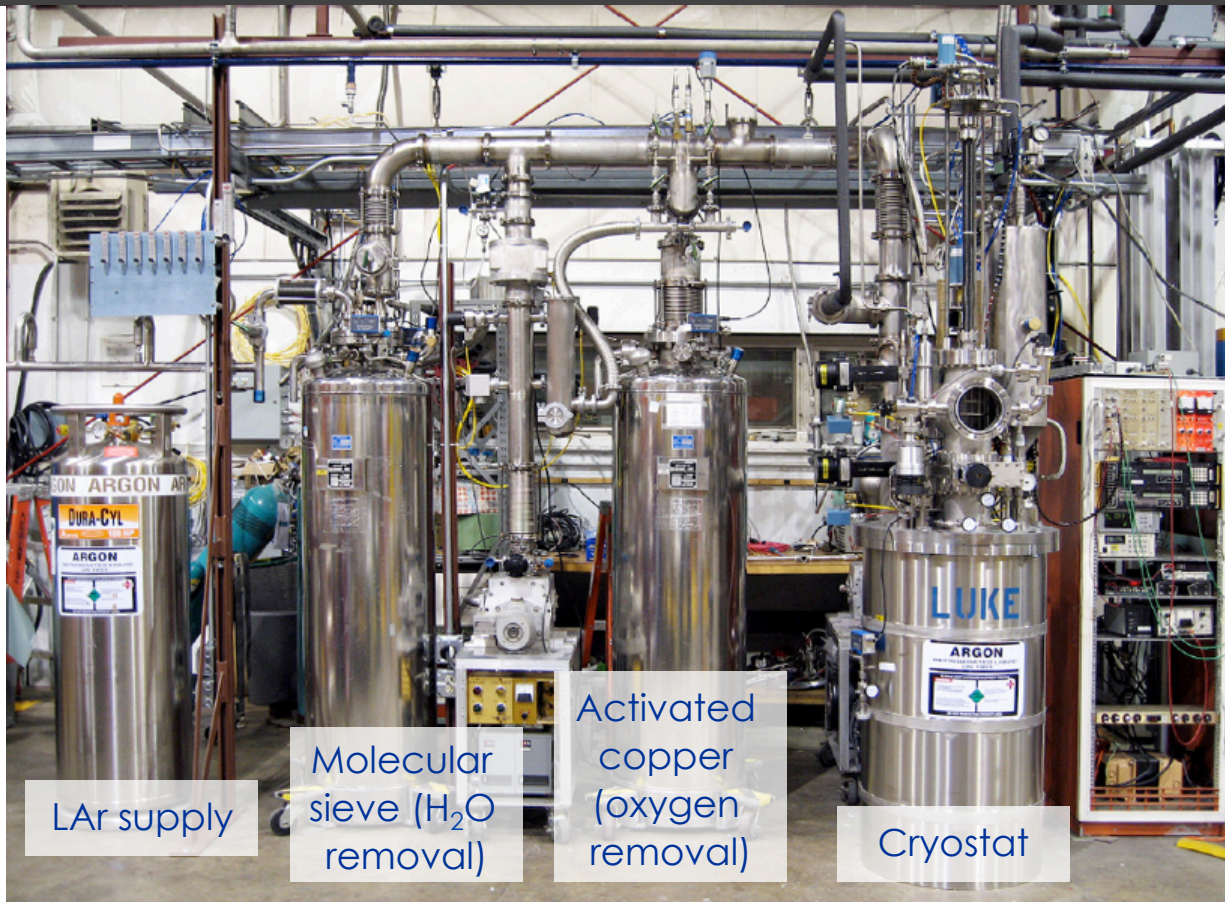
# Proton Assembly Building

- Existing infrastructure built/used over the past decade to support cryogenic tests
  - Technician support
  - Supply of clean argon through filtration system
  - Several in-line cryostats
    - “TallBo” (primarily used for light collection studies, but could fit a small TPC or other devices)
    - “Blanche” (currently used for high voltage studies, could be used for other R&D in the future)
  - Gas analyzers and switchyard
  - Gas injection system
- Materials Test Stand
  - Study impact of materials on LAr purity
- Cosmic Ray Test Stand
  - Study TPC electronics
- LAr Distillation Column
  - Source of clean, isotopically pure argon



Contact: Brian Rebel  
<http://detectors.fnal.gov/facilities.html>

# Materials Test Stand (MTS)

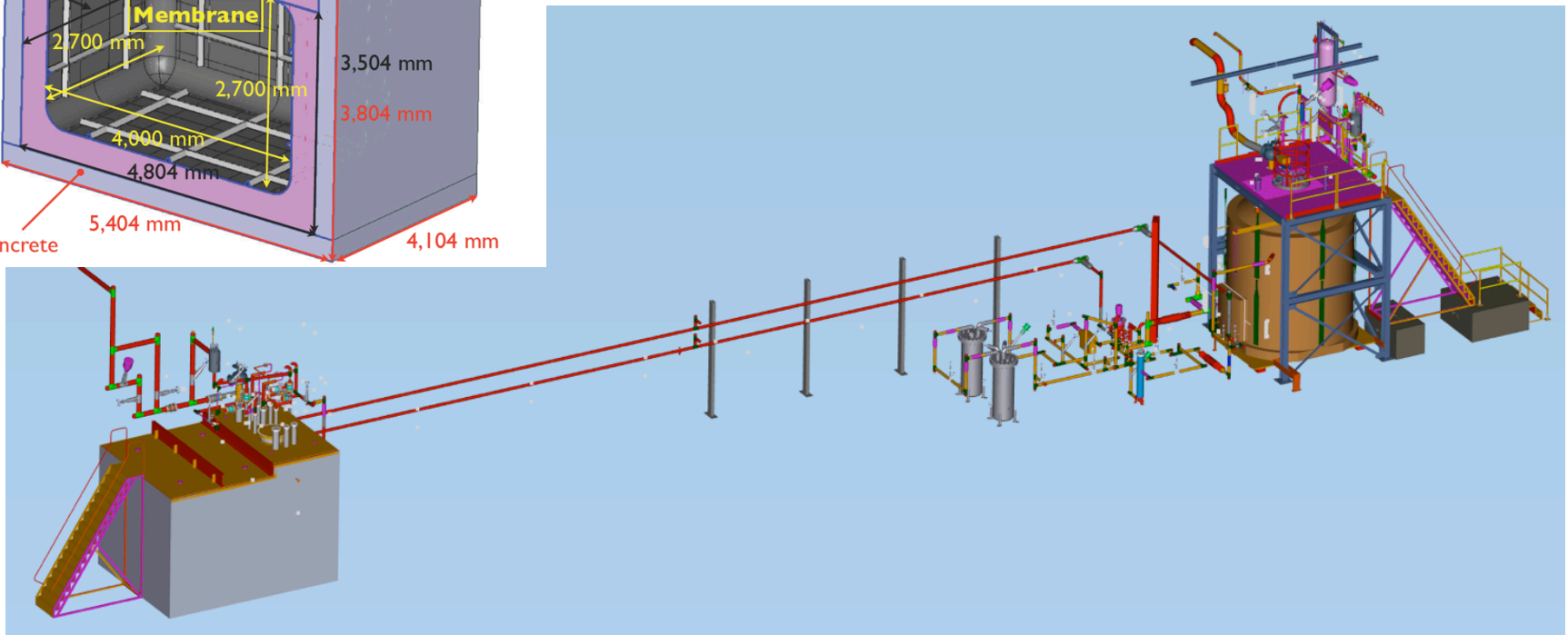
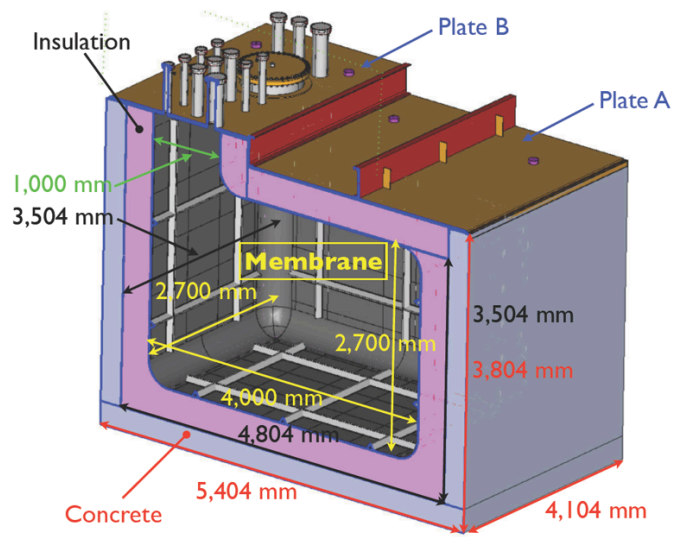


- For development of purification techniques and qualification of materials that are intended for use in LArTPCs
- Cryostat has airlock to allow insertion of materials; sample cage (1000 cm<sup>3</sup>) can be placed at any depth
- Can also inject known contamination of gases



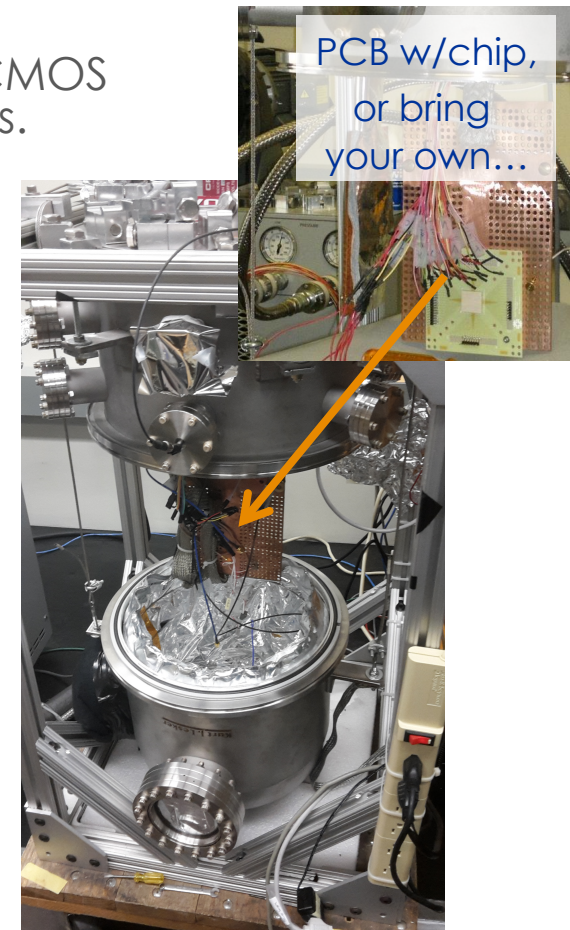
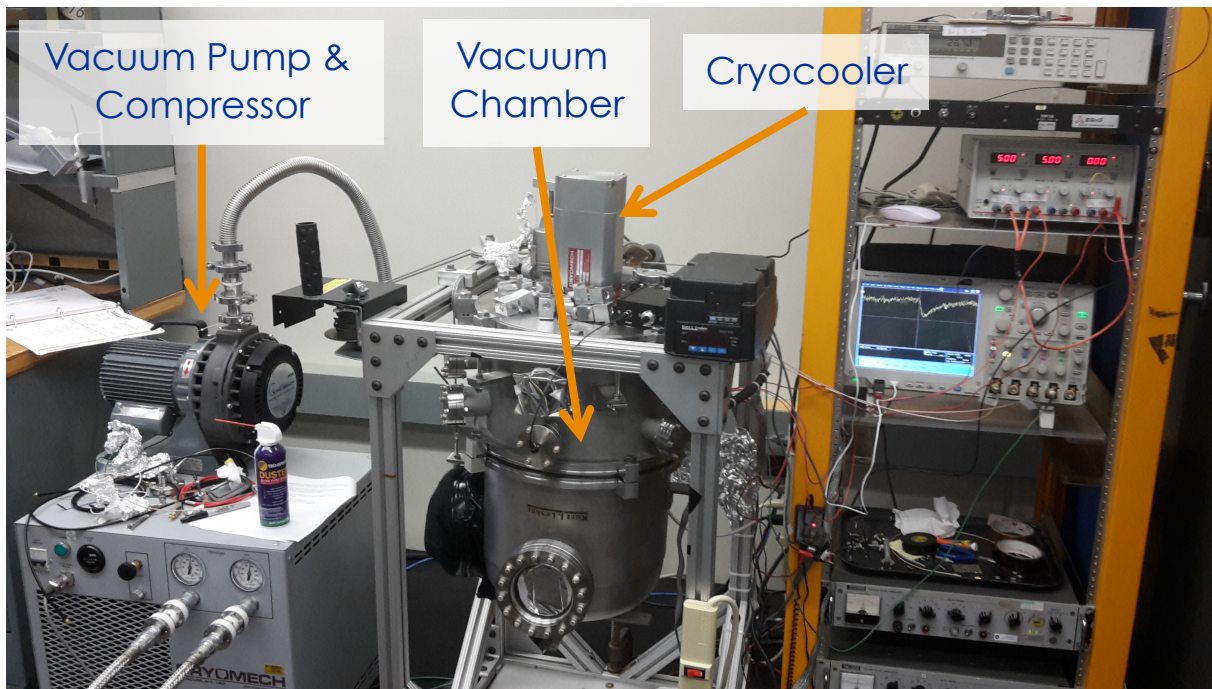
# PC4 Building

- Host to DUNE 35-ton membrane cryostat and LAPD (30-ton foam-insulated cryostat)
- Shared cryogenic recirculation/filtration system
- Could be repurposed in future for additional R&D or tests



# Cold electronics test workshop

- ❑ Cold plate within cryogenic vacuum chamber with multi-source measurement unit (NI PXIe-1085) and Labview control/data acquisition
- ❑ Test electronics @ LAr or LN<sub>2</sub> temperatures
- ❑ Designed for DUNE accelerated stress tests of CMOS transistors. Can also be used for other devices.
- ❑ **Contact: Grzegorz Deptuch**



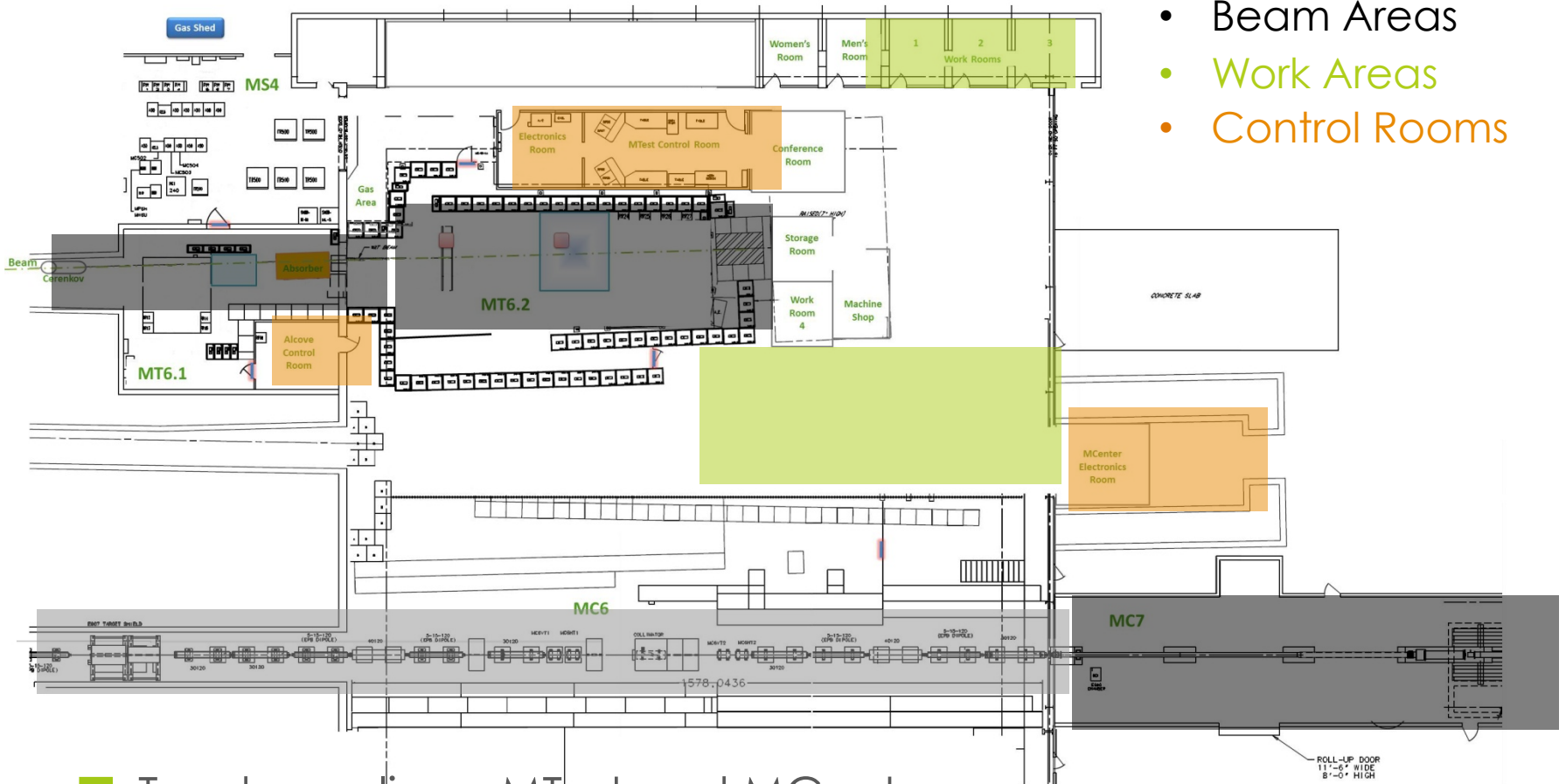


# Fermilab Test Beam Facility (FTBF)



- 120 GeV primary proton beam
- Tunable secondary beams (1-66 GeV). Beam composition and spread depend on beam energy
- Tunable tertiary beam in MCenter (~0.2-2 GeV)

# Facility Layout



- Two beamlines: MTest and MCenter
- MTest is dedicated to short-term (~few weeks) experiments
- MCenter hosts longer term experiments, and has cryogenic infrastructure



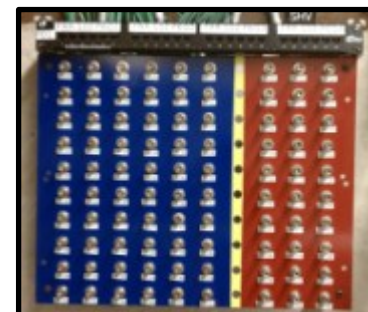
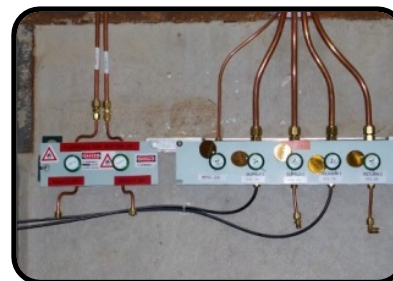
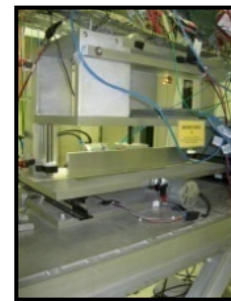
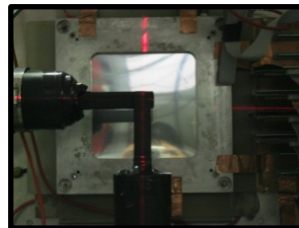
# MCenter Beamline

- Currently in use by LArIAT for characterizing LArTPC response to a known beam of charged particles, and for cross section measurements
- Existing LAr cryogenic system can support future users when LArIAT is completed
- Instrumented with TOF and MWPCs for tagging and momentum analysis of tertiary beam particles



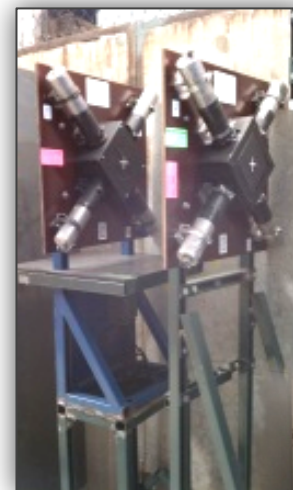
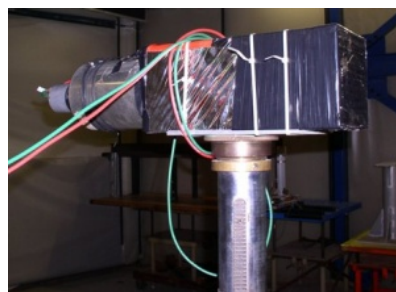
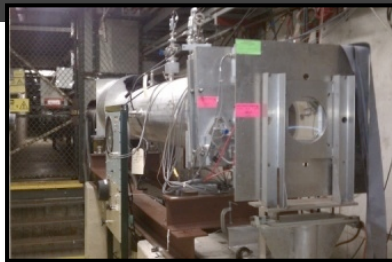
# Facility Infrastructure

- Remotely-controllable motion tables (MTest)
- Laser Alignment (MTest)
- Helium Tubes
- Web-based cameras
- Crane coverage (30 tons, MTest)
- Climate-controlled huts
- Gas patch panels
- Signal, network, and HV cable patch panels



# Facility Instrumentation

- 2 Cherenkov detectors
- 2 pixel telescopes
- 4 MWPC tracking system
- Time of Flight system
- Lead glass calorimeters
- Assorted trigger scintillators




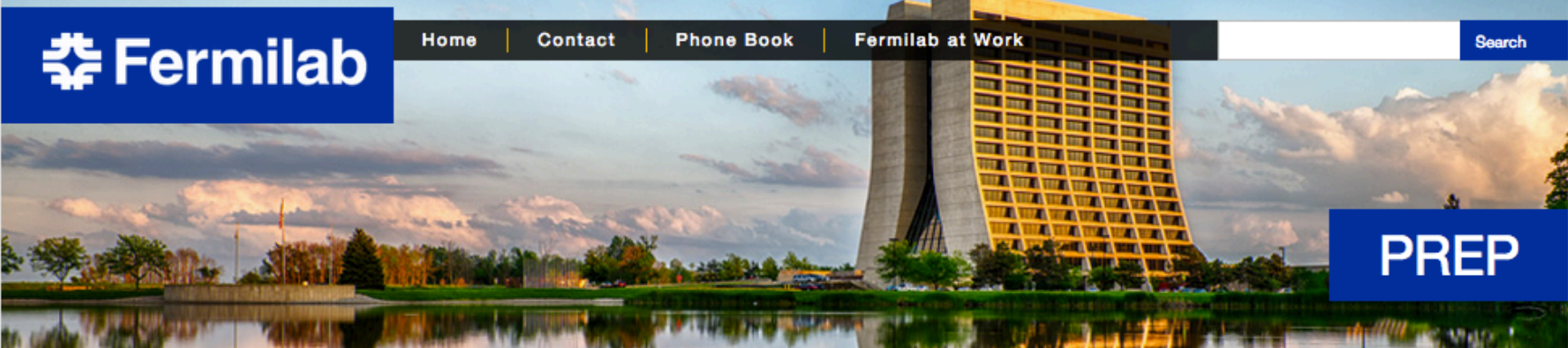
Contact: Mandy Rominsky

<http://ppd.fnal.gov/ftbf>



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### CONTACT

Email: [prep@fnal.gov](mailto:prep@fnal.gov)

Phone: [+1 \(630\) 840-3447](tel:+16308403447)

Location: Feynman Computing Center, 1st Floor East

Hours: 9:30-11:30AM & 12:30-3:00PM

[Shipping Address](#)



# Summary

- As budget resources are squeezed, making the best use of what we have available will allow continued advances in LAr R&D. Colleagues from universities and other labs are welcome and encouraged to use these facilities.
- Existing infrastructure and facilities for a variety of testing needs
  - CERN: dewars & cryostats, with slow controls/monitoring
  - CERN: clean room and working areas
  - CERN: test beam ( $\sim 0.5\text{-}20$  GeV)
  - FNAL: dewars, cryostats, and materials test stand, with cryogenic controls
  - FNAL: cold electronics test stand, working areas, equipment pool
  - FNAL: test beam ( $\sim 0.2\text{-}2$  GeV)
- Neutrino detector R&D facilities workshop at Fermilab, January 20-21, 2016

# Neutrino Detector R&D Facilities Workshop

20-21 January 2016 *Building 327*  
US/Central timezone

 **Search**

<https://indico.fnal.gov/conferenceDisplay.py?confId=10548>

## Overview

Timetable

Registration

Registration  
Form

Secure Credit Card  
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Only

Registrants List

Announcements

Directions

Accommodations

Reception

Computing Access  
& Security Rules

Organizing  
Committees

 [Support](#)



This workshop will introduce the neutrino user community to the detector research and development facilities available at Fermilab. There will be tours of the facilities and presentations on how to get started using them. We will also have presentations from former and current users on their experiences.

We are also very interested in feedback from the community on ways to improve the facilities to maximize their benefit to the community. There will be a session devoted to this feedback as well.

**Dates:** from January 20, 2016 09:00 to January 21, 2016 18:00

**Timezone:** US/Central

**Location:** *Building 327*  
Fermi National Accelerator Laboratory  
Batavia, Illinois  
Room: The Big Room

**Chairs:** [Dr. Rebel, Brian](#)

**Additional info:** A registration fee of \$35 is being charged for participation in this meeting. This fee covers coffee breaks, supplies, and administrative costs of organizing the meeting.